Polychlorinated Biphenyls in Non-carbon Copy Paper

by Masanori Kuratsune and Yoshito Masuda*

In an effort to clarify the distribution of polychlorinated biphenyls (PCBs) in our environment, it was suggested by Dr. T. Hirayama, National Cancer Center, [Japan] that PCBs or their related compounds might be used for production of non-carbon copy paper. Three of 4 Japanese brands of the paper on the market were, therefore, collected and examined for PCBs. The paper consists of three different sheets, namely upper, middle, and lower ones. These sheets of paper were separately extracted with acetone in a Soxhlet apparatus for 3 days. The extracts were examined by gas chromatography with an electron capture detector, using 3 different liquid phases, namely 5% SE-30, 5% QF-1, and 2.5% DEGS coated on Chromosorb W AW DMCS. The gas chromatographic patterns observed were all identical with that of Kanechlor-300 (a commercial brand of PCBs) containing 43% of chlorine (Fig. 1). The infrared absorption spectra and mass-spectra of the extracts also demonstrated the presence of Kanechlor-300. The approximate concentration of PCBs was 2–6% in the upper and middle sheets and 0.02% in the lower sheets as shown in Table 1.

To estimate how much PCBs stick to fingers by handling the copy papers, a set of 96 precut sheets of the same size paper, consisting of 32 sheets of each of the upper, middle, and lower ones, was counted by turning over all the sheets one by one by fingers. After counting, the fingers were washed with n-hexane once and the resulting n-hexane washings were examined for PCBs. The amount of PCBs in the washings, calculated as Kanechlor-300, ranged from 11.40 to 52.68 μg in 5 subjects (Table 2). It was proved thus that PCBs in the paper easily stick to fingers when handled. It was also demonstrated that only one third of the PCBs stuck to fingers can be removed by ordinary hand washing with soap and water (Table 2).

In addition to the above domestic brands of [Japanese] paper, a few other samples of non-carbon copy paper were analyzed for PCBs. One of them was a brand made by one of the leading paper makers in Britain and was obtained as packed in its original container in May, 1971. Analysis showed that both upper and middle

Table 1. Amounts of PCB in carbonless copying paper.

Brand	Kind of paper	Weight of paper (g/100 cm²)	Amount of acetone extract[a] (mg/g)	Amount of PCB found[b] (mg/g)
A	Upper	0.47	117.0	64.7
	Middle	0.56	125.8	63.8
	Lower	0.51	23.4	0.24
B	Upper	0.48	40.8	30.7
	Middle	0.55	37.8	26.0
	Lower	0.51	79.8	0.28
C	Upper	0.40	59.6	31.6
	Middle	0.53	61.0	22.2
	Lower	0.50	28.2	0.20

[a] Weight of extract per weight of paper.

[b] Weight of PCB calculated as Kanechlor-300 per weight of paper.

* Department of Public Health, Faculty of Medicine, Kyushu University and Department of Analytical Chemistry, Daiichi College of Pharmaceutical Sciences, Fukuoka, Japan.

sheets of this make contained PCBs. The second sample, which was of American make and obtained as packed in its original container in June, 1971, also contained a considerable amount of PCBs. Another sample of paper, which was sent to us for examination by a company in Thailand, however, did not contain PCBs. We were told that it is also of American make. A sample of non-carbon copy paper which was used by the U.S. Printing Office in 1967 was obtained from the American Consulate in Fukuoka and analyzed for PCBs. It also contained a large amount of PCBs.

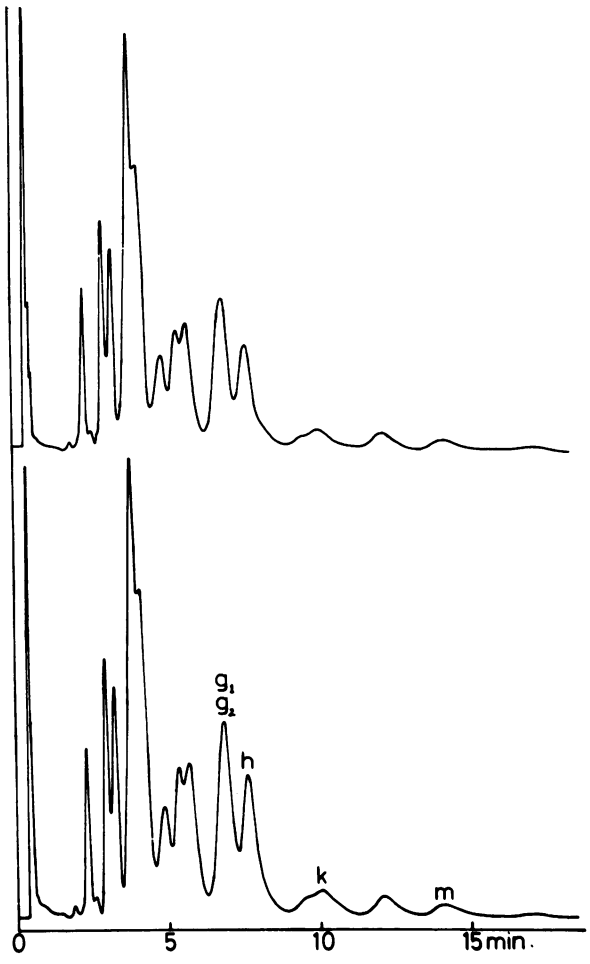

FIGURE 1. Gaschromatograms of kanechlor-300 (upper) and the acetone extract of copying paper (lower). Column: Glass column (3mm×2m) containing 5% SE-30 on chromosorb W AW DMCS. Column temperature: 195°C.

Table 2. Amounts of PCB found from fingers after counting 96 sheets of paper.

Subject	Amount of PCB[a]	
	Washed with n-hexane (μg)	Washed with n-hexane after hand washing with soap (μg)
1	29.76	16.39
2	12.60	10.47
3	11.40	3.50
4	52.68	47.15
5	44.68	25.45
Average	30.22	20.60
Standard deviation	16.60	15.11

[a] Calculated as Kanechlor-300.

Needless to say, the free use of PCBs for this kind of very popular copy paper necessarily leads to the uncontrollably heavy, direct exposure of the general population to it. In view of its chemical and pathological characteristics, we consider that the use of PCBs for copy paper should be discontinued in any country in order to prevent another occurrence of "Yusho". The Japanese makers of the paper are said to have acted quickly along this line in April, 1971. To our regret, however, there have been no control measures set up by the government against the use of PCBs and a considerable amount of the PCB-polluted papers are still widely used in Japan.